R.V. Base

BRITISH STANDARD 1806 : 1951

DIMENSIONS OF TOROIDAL SEALING RINGS

BRITISH STANDARDS INSTITUTION

BRITISH STANDARD SPECIFICATION

DIMENSIONS OF TOROIDAL SEALING RINGS

AND THEIR RECOMMENDED HOUSINGS

B.S. 1806 : 1951

Price 3/– net

BRITISH STANDARDS INSTITUTION
Incorporated by Royal Charter
Telegrams : Standards, Sowest, London Telephone : Abbey 3333
Sales Branch Telephone : Victoria 0522
24 VICTORIA STREET, LONDON, S.W.1

THIS BRITISH STANDARD, having been approved by the Mechanical Engineering Industry Standards Committee and endorsed by the Chairman of the Engineering Divisional Council, was published under the authority of the General Council on 31st December, 1951.

The Institution desires to call attention to the fact that this British Standard does not purport to include all the necessary provisions of a contract.

In order to keep abreast of progress in the industries concerned, British Standards are subject to periodical review. Suggestions for improvements will be recorded and in due course brought to the notice of the committees charged with the revision of the standards to which they refer.

A complete list of British Standards, numbering over 1700, indexed and cross-indexed for reference, together with an abstract of each standard will be found in the Institution's Yearbook, price 7s. 6d.

British Standards are revised, when necessary, by the issue either of amendment slips or of revised editions. It is important that users of British Standards should ascertain that they are in possession of the latest amendments or edition.

CONTENTS

	Page
Co-operating organizations	4
Foreword	5

SPECIFICATION

1. Scope	5
2. Application	6
3. Dimensions and seal numbers	6
4. Tolerances	9
5. Surface finish	12
6. Lead-in chamfer	12

CO-OPERATING ORGANIZATIONS

The Mechanical Engineering Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations :—

*Admiralty
Air Ministry
Associated Offices Technical Committee
Association of Consulting Engineers (Incorporated)
British Chemical Plant Manufacturers' Association
British Compressed Air Society
*British Electrical and Allied Manufacturers' Association
*British Engineers' Association
British Internal Combustion Engine Manufacturers' Association
British Iron and Steel Federation
British Railways, The Railway Executive
Crown Agents for the Colonies
Department of Scientific and Industrial Research
Engineering Equipment Users' Association
Institute of Marine Engineers
Institute of Petroleum
Institution of Civil Engineers
Institution of Gas Engineers
Institution of Heating and Ventilating Engineers
Institution of Mechanical Engineers
Institution of Mechanical Engineers (Automobile Division)
Institution of Production Engineers
Locomotive Manufacturers' Association
Machine Tool Trades' Association
Ministry of Fuel and Power
Ministry of Labour and National Service (Factory Department)
*Ministry of Supply
Ministry of Transport
Ministry of Works
Office of the High Commissioner for India
War Office

The Government departments and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this standard :—

Hydraulic Association
Oil Seal Manufacturers' Association

BRITISH STANDARD SPECIFICATION FOR

THE DIMENSIONS OF TOROIDAL SEALING RINGS

(' O ' SEALS) AND THEIR RECOMMENDED HOUSINGS

FOREWORD

The preparation of this British Standard, under the authority of the Mechanical Engineering Industry Standards Committee, was undertaken at the request of the Inter-Services Engineering Standards Co-ordinating Committee of the Ministry of Defence, the standard being based upon proposals submitted by that Committee.

It is desired to stress that the dimensions given in this standard, although providing the necessary basis for standardization in the manufacture and application of hydraulic seals, should not be regarded as providing all the information required for design purposes. Because of the restricted scope of the standard, attention is drawn to the desirability of consultation, between users and designers on the one hand and the manufacturers of the ' O ' seals on the other, as to the application of this type of seal. A particular case where this consultation is of importance relates to the use of ' O ' seals at pressures in excess of 1500 lb/sq. in. ; in these cases the housing dimensions may need modification and other unspecified factors become of increasing importance.

Users of the standard should note that applications of these sealing rings may be claimed to be subject to patent rights in countries other than the United Kingdom.

SPECIFICATION

SCOPE

1. This British Standard applies to the dimensions of toroidal sealing rings (' O ' seals) of the shape shown in Fig. 1 (page 6) for reciprocating mechanisms (packings) and for static purposes (gaskets) for light and medium general engineering purposes, within the range of nominal sizes given below.

Application	Section diameter	Internal diameter	External diameter
	in.	in.	in.
Reciprocating mechanisms	1/16–1/4	1/8–8	1/4–8 1/2
Static purposes	1/16–1/4	1/8–15 1/2	1/4–16

It also includes, in Tables 4 and 5, the recommended sizes of housings for these rings for normal working pressures up to 1500 lb/sq. in.

APPLICATION

2. Sealing rings of the dimensions given in Table 1 are intended for use with reciprocating mechanisms, or for static purposes.

The sealing rings covered by Table 2 are intended for static purposes only and any other application should only be taken after due consideration of all the factors involved.

As the efficient use of these sealing rings depends upon a number of factors not dealt with in this standard, it is recommended that the manufacturer should be consulted as to the method of application.

The rings are normally suitable for use at pressures in excess of 1500 lb/sq. in., but in these cases it is essential that the manufacturer of the ' O ' seals should be consulted.

Recommended limiting diameters of recesses are given in Table 3 and recommended recess dimensions are given in Tables 4 and 5.

The types of sealing rings and housings referred to in this standard may be used for rotating shafts where peripheral speeds are low but these should be regarded as special cases requiring careful design and close collaboration with the manufacturer of the rings.

DIMENSIONS AND SEAL NUMBERS

3. Tables 1 and 2 set out the nominal dimensions of the sealing rings together with the dimensions and tolerances to which the sealing rings are normally produced.

Each sealing ring has a reference number allotted to it in the tables.

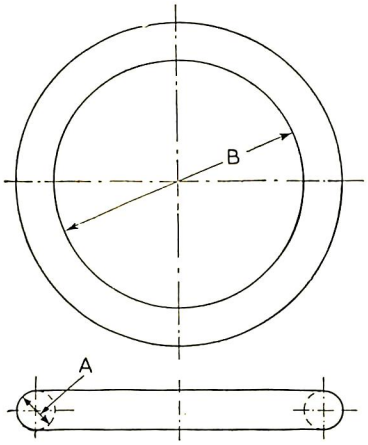

Fig. 1. Toroidal sealing rings (' O ' seals)

TABLE 1. TOROIDAL SEALING RINGS ('O' SEALS) FOR RECIPROCATING MECHANISMS (PACKINGS), AND FOR STATIC PURPOSES (GASKETS) (see Fig. 1)

Standard 'O' seal No.	Nominal diameters			Actual diameters			
	Cross-section	Internal	External	Cross-section A		Internal B	
				dia.	tol.	dia.	tol.
	in.	in.	in.	in.	in.	in.	in.
OS. 1		1/8	1/4	0·070		0·114	
OS. 2		5/32	9/32	0·070		0·145	
OS. 3		3/16	5/16	0·070		0·176	
OS. 4	1/16	7/32	11/32	0·070		0·208	
OS. 5		1/4	3/8	0·070		0·239	
OS. 6		5/16	7/16	0·070		0·301	
OS. 7		3/8	1/2	0·070	±0·003	0·364	±0·005
OS. 8		3/8	9/16	0·103		0·362	
OS. 9		7/16	5/8	0·103		0·424	
OS. 10		1/2	11/16	0·103		0·487	
OS. 11	3/32	9/16	3/4	0·103		0·549	
OS. 12		5/8	13/16	0·103		0·612	
OS. 13		11/16	7/8	0·103		0·674	
OS. 14		3/4	15/16	0·103		0·737	
OS. 15		3/4	1	0·139		0·734	
OS. 16		13/16	1 1/16	0·139		0·796	
OS. 17		7/8	1 1/8	0·139		0·859	
OS. 18		15/16	1 3/16	0·139		0·921	
OS. 19		1	1 1/4	0·139		0·984	
OS. 20		1 1/16	1 5/16	0·139		1·046	
OS. 21	1/8	1 1/8	1 3/8	0·139	±0·004	1·109	±0·006
OS. 22		1 3/16	1 7/16	0·139		1·171	
OS. 23		1 1/4	1 1/2	0·139		1·234	
OS. 24		1 5/16	1 9/16	0·139		1·296	
OS. 25		1 3/8	1 5/8	0·139		1·359	
OS. 26		1 7/16	1 11/16	0·139		1·421	
OS. 27		1 1/2	1 3/4	0·139		1·484	
OS. 28		1 1/2	1 7/8	0·210		1·475	
OS. 29		1 5/8	2	0·210		1·600	
OS. 30		1 3/4	2 1/8	0·210		1·725	
OS. 31		1 7/8	2 1/4	0·210		1·850	
OS. 32	3/16	2	2 3/8	0·210	±0·005	1·975	±0·010
OS. 33		2 1/8	2 1/2	0·210		2·100	
OS. 34		2 1/4	2 5/8	0·210		2·225	
OS. 35		2 3/8	2 3/4	0·210		2·350	
OS. 36		2 1/2	2 7/8	0·210		2·475	
OS. 37		2 5/8	3	0·210		2·600	

TABLE 1 (continued)

Standard 'O' seal No.	Nominal diameters			Actual diameters			
	Cross-section	Internal	External	Cross-section A		Internal B	
				dia.	tol.	dia.	tol.
	in.	in.	in.	in.	in.	in.	in.
OS. 38		2¾	3⅛	0·210		2·725	
OS. 39		2⅞	3¼	0·210		2·850	
OS. 40		3	3⅜	0·210		2·975	
OS. 41		3⅛	3½	0·210		3·100	
OS. 42		3¼	3⅝	0·210		3·225	
OS. 43		3⅜	3¾	0·210		3·350	
OS. 44		3½	3⅞	0·210		3·475	
OS. 45	3/16	3⅝	4	0·210	±0·005	3·600	±0·015
OS. 46		3¾	4⅛	0·210		3·725	
OS. 47		3⅞	4¼	0·210		3·850	
OS. 48		4	4⅜	0·210		3·975	
OS. 49		4⅛	4½	0·210		4·100	
OS. 50		4¼	4⅝	0·210		4·225	
OS. 51		4⅜	4¾	0·210		4·350	
OS. 52		4½	4⅞	0·210		4·475	
OS. 53		4½	5	0·275		4·475	
OS. 54		4⅝	5⅛	0·275		4·600	
OS. 55	¼	4¾	5¼	0·275	±0·006	4·725	±0·015
OS. 56		4⅞	5⅜	0·275		4·850	
OS. 57		5	5½	0·275		4·975	
OS. 58		5⅛	5⅝	0·275		5·100	
OS. 59		5¼	5¾	0·275		5·225	
OS. 60		5⅜	5⅞	0·275		5·350	
OS. 61		5½	6	0·275		5·475	
OS. 62		5⅝	6⅛	0·275		5·600	
OS. 63		5¾	6¼	0·275		5·725	
OS. 64	¼	5⅞	6⅜	0·275	±0·006	5·850	±0·023
OS. 65		6	6½	0·275		5·975	
OS. 66		6¼	6¾	0·275		6·225	
OS. 67		6½	7	0·275		6·475	
OS. 68		6¾	7¼	0·275		6·725	
OS. 69		7	7½	0·275		6·975	
OS. 70		7¼	7¾	0·275		7·225	
OS. 71		7½	8	0·275		7·475	
OS. 72	¼	7¾	8¼	0·275	±0·006	7·725	±0·030
OS. 73		8	8½	0·275		7·975	

TABLE 2. TOROIDAL SEALING RINGS ('O' SEALS) FOR STATIC PURPOSES (GASKETS) (see Fig. 1)

For sizes OS.1 to OS.73 see Table 1.

Standard 'O' seal No.	Nominal diameters			Actual diameters			
	Cross-section	Internal	External	Cross-section A		Internal B	
				dia.	tol.	dia.	tol.
	in.	in.	in.	in.	in.	in.	in.
OS. 74		8¼	8¾			8·225	
OS. 75		8½	9			8·475	
OS. 76		8¾	9¼			8·725	
OS. 77		9	9½			8·975	
OS. 78		9¼	9¾			9·225	
OS. 79		9½	10			9·475	
OS. 80		9¾	10¼			9·725	
OS. 81	¼	10	10½	0·275	±0·006	9·975	±0·030
OS. 82		10¼	10¾			10·225	
OS. 83		10½	11			10·475	
OS. 84		10¾	11¼			10·725	
OS. 85		11	11½			10·975	
OS. 86		11¼	11¾			11·225	
OS. 87		11½	12			11·475	
OS. 88		11¾	12¼			11·725	
OS. 89		12	12½			11·975	
OS. 90		12½	13			12·475	
OS. 91		13	13½			12·975	
OS. 92	¼	13½	14	0·275	±0·006	13·475	±0·030
OS. 93		14	14½			13·975	
OS. 94		14½	15			14·475	
OS. 95		15	15½			14·975	
OS. 96		15½	16			15·475	

TOLERANCES

4. The tolerances for mating metal parts of the seal housing should be selected by the designer in consultation with the 'O' seal manufacturer. In all cases it is important that the maximum diametral clearance 'G' quoted in Table 4 (page 13) should not be exceeded.

The limiting dimensions for recess diameters are dependent on the diameters and the tolerances selected for the shafts and cylinders and recommended maximum limits permissible are given in Table 3.

The tolerances on groove width for dynamic and static applications and groove diameters for flange applications shall be in accordance with Tables 4 and 5 respectively.

TABLE 3. RECOMMENDED LIMITING DIAMETERS OF RECESSES

Standard 'O' seal No.	For dynamic and static applications			
	Piston recess dia. C for cylinder dia. D (Fig. 2)		Gland recess dia. D for shaft dia. C (Fig. 3)	
	max.	min.	max.	min.
	in.	in.	in.	in.
OS. 1 to OS. 7	$D_{min.}-0{\cdot}120$	$D_{max.}-0{\cdot}125$	$C_{min.}+0{\cdot}125$	$C_{max.}+0{\cdot}120$
OS. 8 to OS. 14	$D_{min.}-0{\cdot}182$	$D_{max.}-0{\cdot}188$	$C_{min.}+0{\cdot}188$	$C_{max.}+0{\cdot}182$
OS. 15 to OS. 27	$D_{min.}-0{\cdot}243$	$D_{max.}-0{\cdot}250$	$C_{min.}+0{\cdot}250$	$C_{max.}+0{\cdot}243$
OS. 28 to OS. 52	$D_{min.}-0{\cdot}367$	$D_{max.}-0{\cdot}375$	$C_{min.}+0{\cdot}375$	$C_{max.}+0{\cdot}367$
OS. 53 to OS. 96	$D_{min.}-0{\cdot}490$	$D_{max.}-0{\cdot}500$	$C_{min.}+0{\cdot}500$	$C_{max.}+0{\cdot}490$

Example. To determine the diameter of recess for 'O' Seal No. OS.25 for use in a gland on a 1⅜ in. diameter shaft it is first necessary to know the limiting diameters of the shaft. Assuming the designer selects the following sizes :—

$$\text{Diameter of shaft} = 1{\cdot}375 - 0{\cdot}0015 \text{ in.} - 0{\cdot}0027 \text{ in.}$$

$$\text{Diameter of bearing} = 1.375 + 0{\cdot}0018 \text{ in.} - 0{\cdot}0 \text{ in.}$$

NOTE. These dimensions give a maximum diametral clearance of ·0045 in., which satisfies the specified condition that this clearance must not exceed ·006 in. for the size of seal (see Table 4).

Then, from Table 3, for 'O' Seal No. OS.25,

$$\text{Max. permissible diameter of gland recess} = C_{min.} + 0{\cdot}250 \text{ in.} = 1{\cdot}375 - 0{\cdot}0027 + 0{\cdot}250 \text{ in.} = 1{\cdot}6223 \text{ in.}$$

$$\text{Min. permissible diameter of gland recess} = C_{max.} + 0{\cdot}243 \text{ in.} = 1{\cdot}375 - 0{\cdot}0015 + 0{\cdot}243 \text{ in.} = 1{\cdot}6165 \text{ in.}$$

These are limiting dimensions and should not be exceeded, but the tolerance may be reduced if so desired, e.g. to 1·622 in. and 1·617 in.

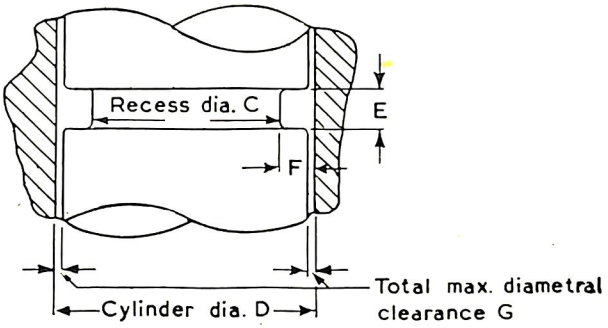

Fig. 2. Dimensions of recess in piston

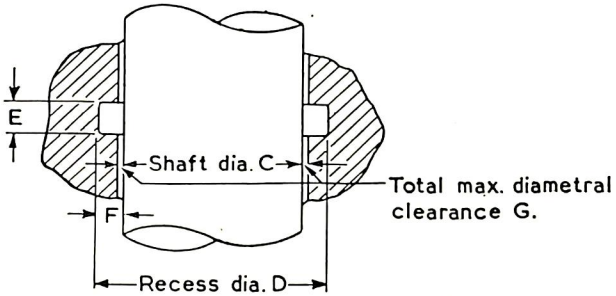

Fig. 3. Dimensions of recess in cylinder

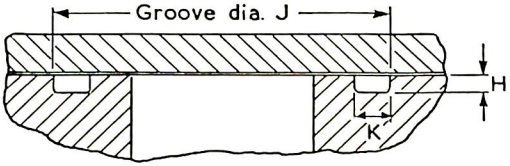

Fig. 4. Dimensions of recess in flange

NOTE. In Figs. 2, 3 and 4 :
Radii on bottom corners of grooves = 0·020 in. to 0·030 in.
Radii on outer edges of grooves = 0·005 in. to 0·010 in.

SURFACE FINISH

5. To obtain maximum life of the 'O' seal, the surface finish of the metal parts in contact with the seal should be as smooth as possible (the better the finish the longer the life).

'LEAD-IN' CHAMFER

6. Where 'lead-in' chamfers are required they shall be in accordance with the dimension given in Fig. 5.

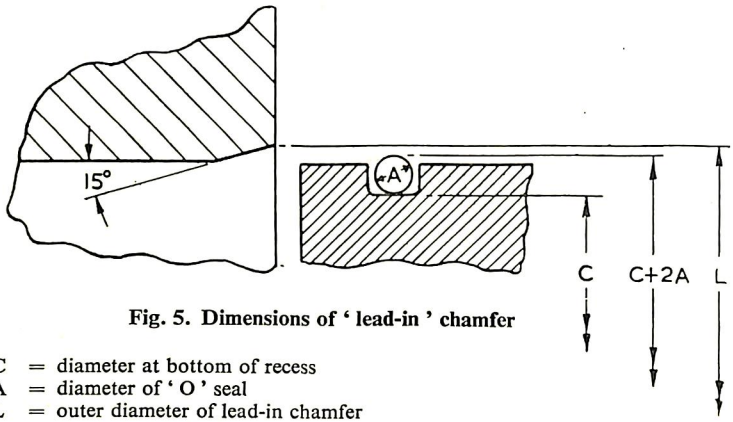

Fig. 5. Dimensions of 'lead-in' chamfer

C = diameter at bottom of recess
A = diameter of 'O' seal
L = outer diameter of lead-in chamfer
= C + 2A + 0·020 in.

TABLE 4. RECOMMENDED RECESS DIMENSIONS FOR 'O' SEALS FOR DYNAMIC AND STATIC APPLICATIONS

(see Figs. 2 and 3)

Standard 'O' seal No.	Nominal shaft or recess dia. C	Nominal cylinder or recess dia. D	Groove width E ± 0·005 in.	Maximum radial width F	Maximum diametral clearance G
	in.	in.	in.	in.	in.
OS. 1	0·125	0·25			
OS. 2	0·1562	0·2812			
OS. 3	0·1875	0·3125			
OS. 4	0·219	0·344	0·094	0·0625	0·005
OS. 5	0·25	0·375			
OS. 6	0·3125	0·4375			
OS. 7	0·375	0·5			
OS. 8	0·375	0·5625			
OS. 9	0·4375	0·625			
OS. 10	0·5	0·6875			
OS. 11	0·5625	0·75	0·141	0·094	0·005
OS. 12	0·625	0·8125			
OS. 13	0·6875	0·875			
OS. 14	0·75	0·9375			
OS. 15	0·75	1·0			
OS. 16	0·8125	1·0625			
OS. 17	0·875	1·125			
OS. 18	0·9375	1·1875			
OS. 19	1·0	1·25			
OS. 20	1·0625	1·3125			
OS. 21	1·125	1·375	0·188	0·125	0·006
OS. 22	1·1875	1·4375			
OS. 23	1·25	1·5			
OS. 24	1·3125	1·5625			
OS. 25	1·375	1·625			
OS. 26	1·4375	1·6875			
OS. 27	1·5	1·75			
OS. 28	1·5	1·875			
OS. 29	1·625	2·0			
OS. 30	1·75	2·125			
OS. 31	1·875	2·25			
OS. 32	2·0	2·375			
OS. 33	2·125	2·5			
OS. 34	2·25	2·625			
OS. 35	2·375	2·75			
OS. 36	2·5	2·875			
OS. 37	2·625	3·0			
OS. 38	2·75	3·125			
OS. 39	2·875	3·25			
OS. 40	3·0	3·375	0·281	0·188	0·007
OS. 41	3·125	3·5			
OS. 42	3·25	3·625			
OS. 43	3·375	3·75			
OS. 44	3·5	3·875			
OS. 45	3·625	4·0			
OS. 46	3·75	4·125			
OS. 47	3·875	4·25			
OS. 48	4·0	4·375			
OS. 49	4·125	4·5			
OS. 50	4·25	4·625			
OS. 51	4·375	4·75			
OS. 52	4·5	4·875			

TABLE 4 (continued)

Standard 'O' seal No.	Nominal shaft or recess dia. C	Nominal cylinder or recess dia. D	Groove width E ± 0·005 in.	Maximum radial width F	Maximum diametral clearance G
	in.	in.	in.	in.	in.
OS. 53	4·5	5·0			
OS. 54	4·625	5·125			
OS. 55	4·75	5·25			
OS. 56	4·875	5·375			
OS. 57	5·0	5·5			
OS. 58	5·125	5·625			
OS. 59	5·25	5·75			
OS. 60	5·375	5·875			
OS. 61	5·5	6·0			
OS. 62	5·625	6·125			
OS. 63	5·75	6·25	0·375	0·25	0·008
OS. 64	5·875	6·375			
OS. 65	6·0	6·5			
OS. 66	6·25	6·75			
OS. 67	6·5	7·0			
OS. 68	6·75	7·25			
OS. 69	7·0	7·5			
OS. 70	7·25	7·75			
OS. 71	7·5	8·0			
OS. 72	7·75	8·25			
OS. 73	8·0	8·5			
		Static applications			
OS. 74	8·25	8·75			
OS. 75	8·5	9·0			
OS. 76	8·75	9·25			
OS. 77	9·0	9·5			
OS. 78	9·25	9·75			
OS. 79	9·5	10·0			
OS. 80	9·75	10·25			
OS. 81	10·0	10·5			
OS. 82	10·25	10·75			
OS. 83	10·5	11·0			
OS. 84	10·75	11·25			
OS. 85	11·0	11·5	0·375	0·25	0·008
OS. 86	11·25	11·75			
OS. 87	11·5	12·0			
OS. 88	11·75	12·25			
OS. 89	12·0	12·5			
OS. 90	12·5	13·0			
OS. 91	13·0	13·5			
OS. 92	13·5	14·0			
OS. 93	14·0	14·5			
OS. 94	14·5	15·0			
OS. 95	15·0	15·5			
OS. 96	15·5	16·0			

TABLE 5. RECOMMENDED RECESS DIMENSIONS FOR 'O' SEALS FOR FLANGE APPLICATION (see Fig. 4)

Standard 'O' seal No.	Groove depth H ± 0·005	Groove diameter J ± 0·010	Minimum groove width K
	in.	in.	in.
OS. 1		0·25	
OS. 2		0·2812	
OS. 3		0·3125	
OS. 4	0·056	0·344	0·094
OS. 5		0·375	
OS. 6		0·4375	
OS. 7		0·5	
OS. 8		0·5625	
OS. 9		0·625	
OS. 10		0·6875	
OS. 11	0·086	0·75	0·141
OS. 12		0·8125	
OS. 13		0·875	
OS. 14		0·9375	
OS. 15		1·0	
OS. 16		1·0625	
OS. 17		1·125	
OS. 18		1·1875	
OS. 19		1·25	
OS. 20		1·3125	
OS. 21	0·115	1·375	0·188
OS. 22		1·4375	
OS. 23		1·5	
OS. 24		1·5625	
OS. 25		1·625	
OS. 26		1·6875	
OS. 27		1·75	
OS. 28		1·875	
OS. 29		2·0	
OS. 30		2·125	
OS. 31		2·25	
OS. 32		2·375	
OS. 33		2·5	
OS. 34		2·625	
OS. 35		2·75	
OS. 36		2·875	
OS. 37		3·0	
OS. 38		3·125	
OS. 39	0·175	3·25	0·281
OS. 40		3·375	
OS. 41		3·5	
OS. 42		3·625	
OS. 43		3·75	
OS. 44		3·875	
OS. 45		4·0	
OS. 46		4·125	
OS. 47		4·25	
OS. 48		4·375	
OS. 49		4·5	
OS. 50		4·625	
OS. 51		4·75	
OS. 52		4·875	

TABLE 5 (continued)

Standard 'O' seal No.	Groove depth H ± 0·005	Groove diameter J ± 0·010	Minimum groove width K
	in.	in.	in.
OS. 53		5·0	
OS. 54		5·125	
OS. 55		5·25	
OS. 56		5·375	
OS. 57		5·5	
OS. 58		5·625	
OS. 59		5·75	
OS. 60		5·875	
OS. 61		6·0	
OS. 62		6·125	
OS. 63		6·25	
OS. 64		6·375	
OS. 65		6·5	
OS. 66		6·75	
OS. 67		7·0	
OS. 68		7·25	
OS. 69		7·5	
OS. 70		7·75	
OS. 71		8·0	
OS. 72		8·25	
OS. 73		8·5	
OS. 74	0·236	8·75	0·375
OS. 75		9·0	
OS. 76		9·25	
OS. 77		9·5	
OS. 78		9·75	
OS. 79		10·0	
OS. 80		10·25	
OS. 81		10·5	
OS. 82		10·75	
OS. 83		11·0	
OS. 84		11·25	
OS. 85		11·5	
OS. 86		11·75	
OS. 87		12·0	
OS. 88		12·25	
OS. 89		12·5	
OS. 90		13·0	
OS. 91		13·5	
OS. 92		14·0	
OS. 93		14·5	
OS. 94		15·0	
OS. 95		15·5	
OS. 96		16·0	

Universal Decimal Classification 62–762

Printed in England by Waterlow & Sons Limited, 49 Parliament Street, Westminster, London, S.W.1. (1500/11/52)